A HISTORICAL YIELD PERFORMANCE IN WESTERN KANSAS

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ABSTRACT

A primary objective in Agronomy is to increase crop yields through improved varieties/hybrids and production practices. Crop variety/hybrid performance tests of irrigated corn, irrigated wheat, dryland wheat, irrigated grain sorghum, dryland grain sorghum, and irrigated soybeans were conducted at the Southwest Research Extension center in Garden City, Kansas annually over the last 50 years. For each crop, the varieties/hybrids yields were averaged for each year from 1956 through 2006. These trial averages were regressed against year to measure the level of crop yield improvement throughout the last 50 year period. The greatest crop improvement has clearly occurred in irrigated corn. During this time period irrigated corn yields increased 2.19 bu/A/year ($P \leq 0.0001$). Corn yields increased primarily through improved corn hybrids. Corn yields were also increased through improved fertility management, weed control practices, insect resistance, and increased plant populations. Irrigated and dryland wheat yields increased 0.28 and 0.25 bu/A/year ($P \leq 0.07$) from varieties with reduced lodging, earlier maturity, increased disease resistance, and improved yield potential. Wheat yields were highly variable throughout the 50 year time period due to environmental conditions. Hot temperatures during grain fill, spring time freezes, rust, and hail reduce and cause significant year to year yield variation. In addition, seasonal precipitation variation contributes to yield variability observed in dryland wheat varieties. These environmental challenges likely mask some of the yield improvements made in wheat varieties. Irrigated grain sorghum has consistently yielded an average of 7,589 lb/A, and dryland grain sorghum yield increased 0.67 bu/A/year ($P \leq 0.001$). Sorghum yields were improved through varieties with reduced lodging and improved yield potential, and better production practices. Group II and III irrigated soybeans have increased 0.22 bu/A/year ($P \leq 0.06$) from varieties with higher yield potential and greater tolerance to iron chlorosis. Variety/hybrid performance tests have and will continue to assist producers make decisions of what varieties or hybrids to plant.

MATERIALS AND METHODS

Crop variety/hybrid performance tests, irrigated corn, irrigated wheat, dryland wheat, irrigated grain sorghum, dryland grain sorghum, and irrigated soybeans were conducted at the SWREC annually over the last 50 years (Southwest Research Extension Center, 1955-2007). For each crop, the varieties/hybrids yields were averaged for each year from 1956 through 2006. These trial averages were regressed against year to measure the level of crop yield improvement throughout the last 50 year period (Holman and Thompson, 2007).

RESULTS AND DISCUSSION

Advancements in irrigated corn yields over the last 50 years have exceeded all other crops evaluated during the same time period at the SWREC. Regression analysis of the irrigated corn performance test averages predicts that irrigated corn yields have increased 2.19 bu/A/year from 1956 through 2006 (Figure 1). The development of corn hybrids as well as fertility, plant population increases, improved weed control practices, and GMO corn borer resistance have all contributed to the increased corn yields. Individual average yields for each year are shown on Figure 1. The lowest average yields were less than 100 bu/A in 1956 and 1957, while the two highest average yields occurred in 2002 and 2003 exceeding 250 bu/A.

Irrigated wheat has had a slight upward trend over the 50 year period (Figure 2). The regression predicts wheat yield improvements of 0.28 bu/A/year from 1956 through 2006. Although huge improvements have been made on reducing wheat lodging and maturity date, and improving disease resistance and variety yield potential, environmental conditions continue to control wheat yields resulting in significant year to year variation. High temperatures during grain fill, freeze damage, rust, and hail contribute to the low yielding years. Omitting the zero yielding years, 2 years had average yields of less than 30 bu/A and 2 years had average yields exceeding 80 bu/A.

Dryland wheat, like irrigated wheat, has had a similar upward trend of 0.25 bu/A/yr from 1956 through 2006 (Figure 3). Growing season precipitation variability along with spring freezes, high temperatures during grain fill, rust, and hail contribute to large variability in dryland wheat yields masking the true increase in wheat variety yield potential improvement. The long term yield variability indicates that the area is a harsh environment for wheat production. In only 17 years since 1956 has the dryland wheat variety trial averaged over 40 bu/A. In fact, 12 years have had average yields of 20 bu/A or less. This includes the 4 years (1967, 1979, 1987, and 1996) that the dryland wheat variety trial was abandoned.

Irrigated grain sorghum yield does not trend upward but remained flat from 1956 through 2006 (Figure 4). The excellent yields in the 1950's and 1960's perhaps were higher than farmer yields since plots were primarily hand harvested. Varieties/hybrids at that time were prone to lodging which significantly reduced the amount of crop a producer could machine harvest. Improvements were made in reducing sorghum lodging by reducing plant height and improving stalkrot resistance which has allowed producers to harvest standing irrigated grain sorghum resulting in increased harvested yields. Greater variation in sorghum yield has occurred since 1983. Four years of the irrigated sorghum hybrid trials were abandon of which three years were due to hail (1967, 1979, and 1992) and one to freeze (1983). It is surprising that the irrigated hybrid sorghum yield averages met or exceeded 100 bu/A in all but four years that yield data was collected. Yet in only three years did the average irrigated sorghum yield exceed 140 bu/A. From 1957 through 2006, irrigated sorghum has consistently yielded 100 to 140 bu/A.

Dryland grain sorghum in a conventional tilled sorghum-fallow rotation yield has trended upward 0.67 bu/A/year from 1956 through 2006 (Figure 5). The increasing trend is a result of hybrid improvements for dryland as well as improved farming practices of fertility and weed control. Since 1990 the occurrence of average yields exceeding 80 bu/A has increased. Like dryland wheat, year to year yield variation is high due to variability in precipitation and other environmental challenges like hail.

Irrigated soybean yields have had a slight upward trend of 0.32 bu/A/year (Figure 6). In five years the soybean variety trial was abandoned and in at least one of those years this was due

to an uncontrollable weed population. In 2002 Roundup Ready soybeans was added to the variety trial. The introduction of Roundup Ready soybeans and other herbicides has greatly improved weed management and helped lead to increased yields.

Variety/hybrid performance tests have and will continue to assist the producer making decisions of what varieties or hybrids should be planted. It's always most important to plant more than one variety or hybrid as well as more than one crop to minimize production risk to environmental and economic conditions.

Figure 1. Irrigated Corn Yield. Yield increased 2.19 bu/year (R^2= 0.55; P<0.0001).

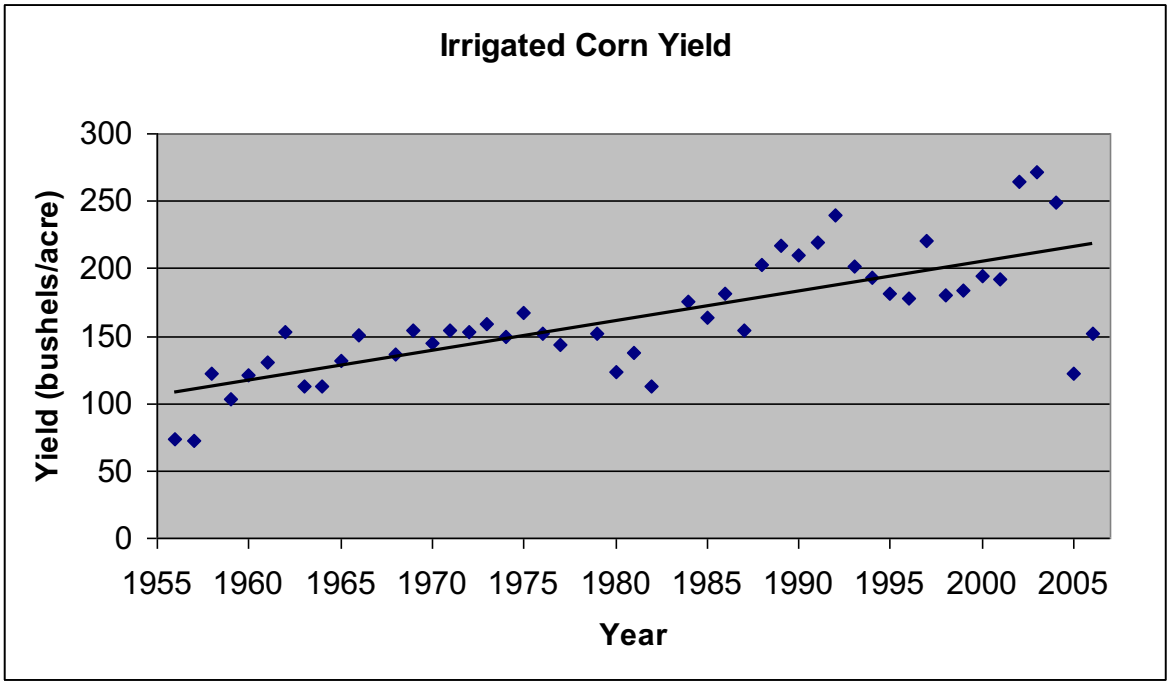


Figure 2. Irrigated Wheat Yield. Yield increased 0.28 bu/year (R^2= 0.05; P<0.07).

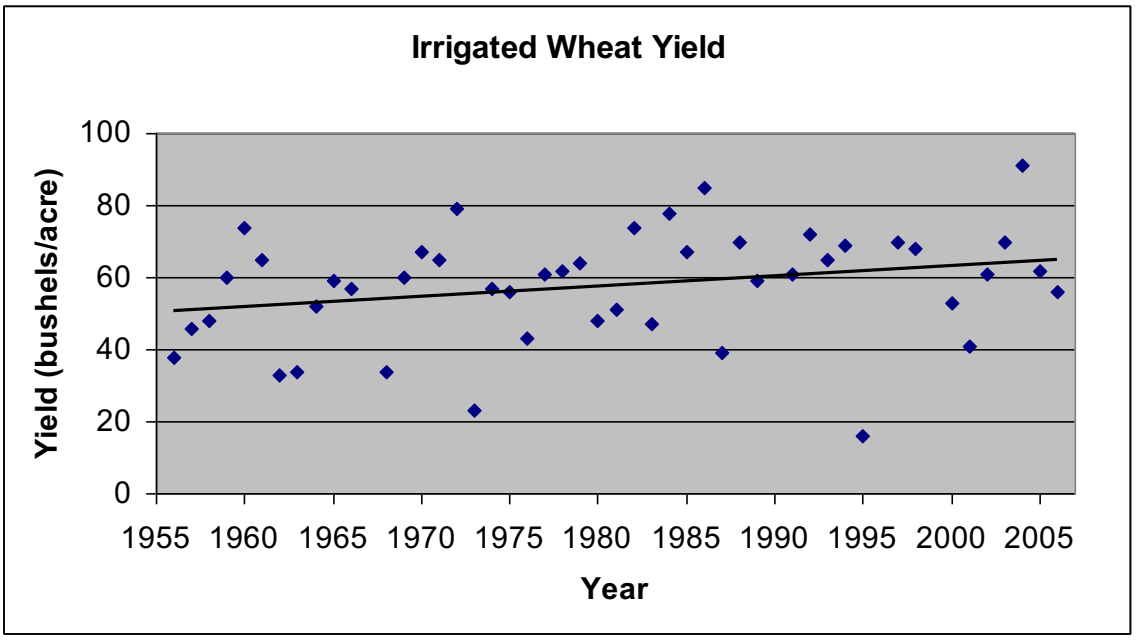


Figure 3. Dryland Wheat Yield. Yield increased 0.25 bu/year (R^2= 0.05; P<0.07).

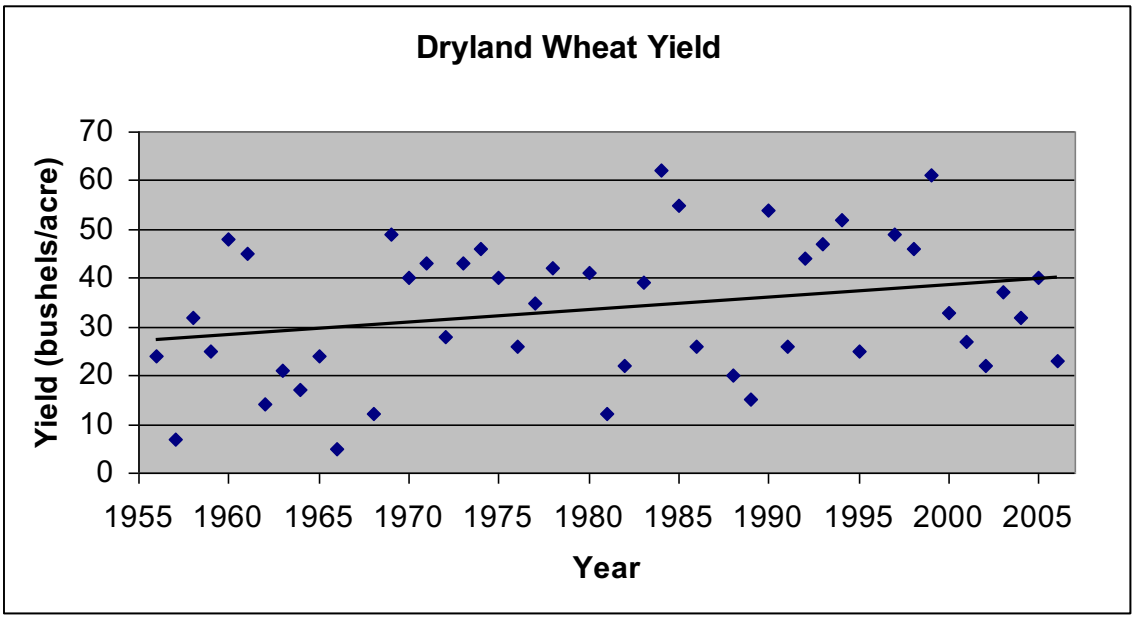


Figure 4. Irrigated Sorghum Yield. Irrigated sorghum yield averaged 121 bu/year (R^2= 0.005; P<0.4).

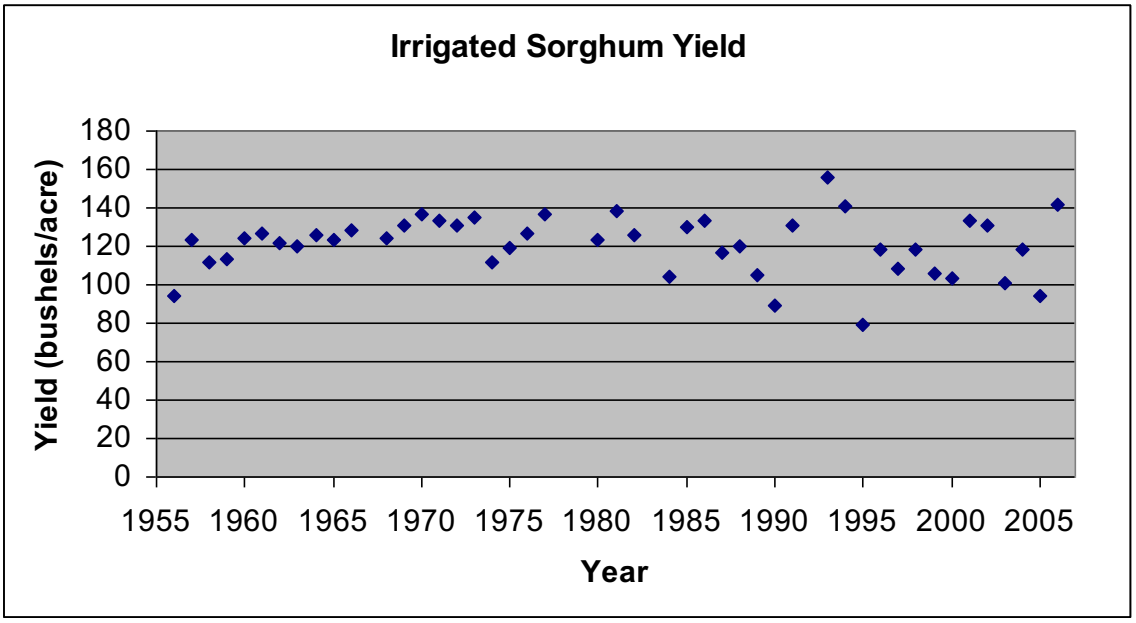


Figure 5. Dryland Sorghum Yield. Yield increased 0.67 bu/year (R^2= 0.20; P<0.001).

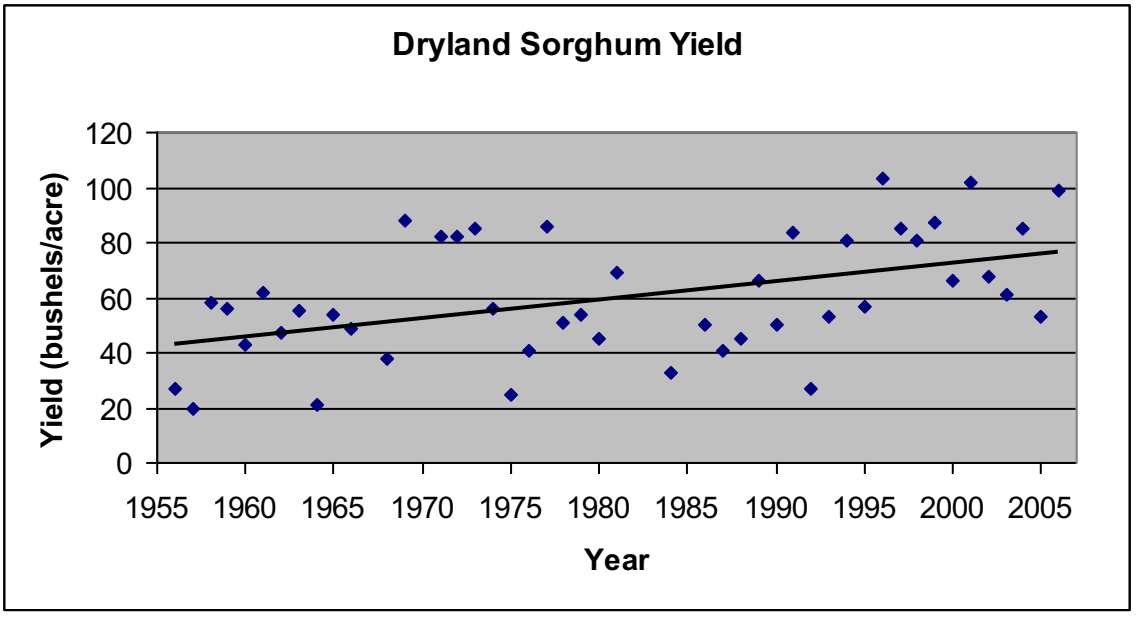
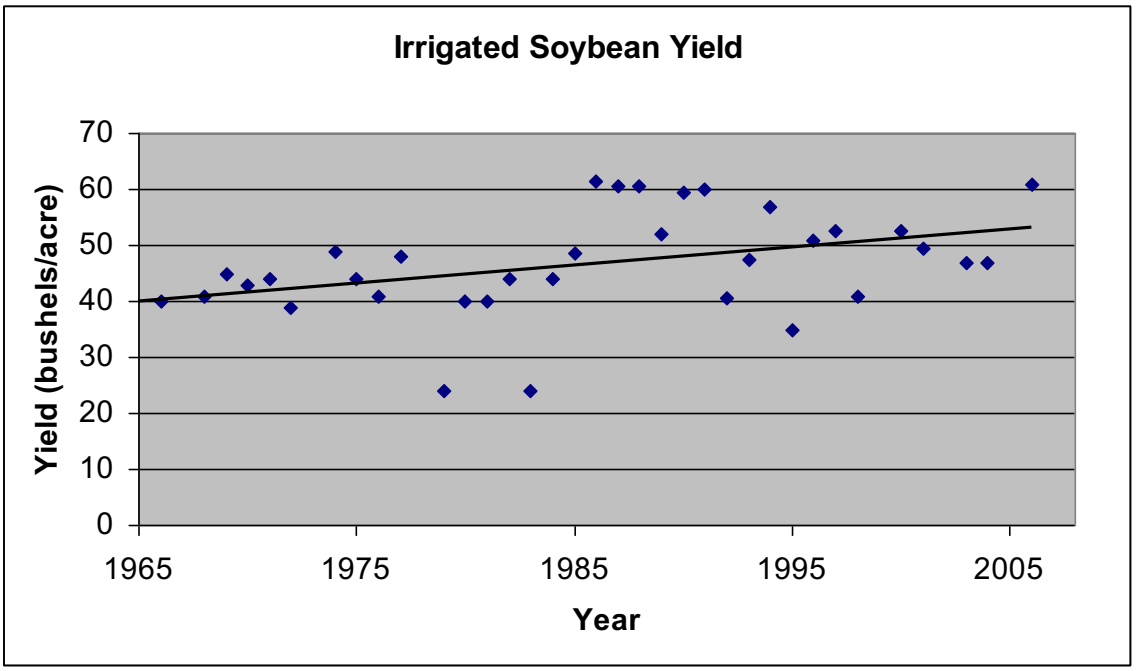


Figure 6. Irrigated Soybean Yield. Yield increased 0.32 bu/year (R^2= 0.16; P<0.02).



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